SP-W5 Project Effects on Groundwater

October 25, 2002

1.0 Introduction/Background

Relicensing participants raised a concern about the effects of the project features and operations on groundwater quality downstream from Oroville Dam. Included in their concern are project-related effects to hyporheic zones along the Feather River. The "hyporheic zone" comprises the interstices or spaces in the mixture of coarse sand, gravel, and other rocks beneath and beside a river or stream. The spaces are permeated by flowing water in contact with that in the stream, and are inhabited by a variety of insects and other aquatic organisms, including fish fry.

Oroville Dam and Lake Oroville are underlain by relatively impermeable Mesozoic-era igneous bedrock. Downstream from the dam, the Feather River and the Thermalito Forebay and Afterbay project features are on much younger and more permeable volcaniclastic and alluvial sediments, where groundwater recharge occurs. Due to the porosity of the underlying deposits, the hydraulic heads of the Thermalito Forebay and Afterbay surface water features, as well as varied project-related releases to the Feather River, probably contribute to locally higher groundwater levels, though the extent of this effect has not been quantified. It is possible also that groundwater quality locally reflects the characteristics of the water within these project features.

Existing and future operation of the Oroville Facilities may have effects on the physical, chemical, and biological components of groundwater quality in the project area. Some physical, chemical, and biological data have been collected from groundwater in the project area. However, these data are not, nor were they expected to be, sufficient to determine compliance with Basin Plan criteria, goals, and objectives (CVRWQCB 1998) established for protection of groundwater beneficial uses. Additional physical, chemical, and biological data are needed to demonstrate project compliance with Basin Plan standards for groundwater.

2.0 Study Objectives

The objectives of this study are to quantify the localized effects on groundwater levels and groundwater quality from Thermalito Forebay and Afterbay operations, as well as from dam releases to the Feather River. The study will include quantifying effects on movement of water within hyporheic zones and determining the hydraulic connectivity between the Feather River and ponds within the Oroville Wildlife Area.)

3.0 Relationship to Relicensing /Need for the Study

Construction of Oroville Dam, impoundment of water to form Lake Oroville, and associated facilities of the project have affected the physical, chemical, and biological characteristics of water in the Feather River. Since the Feather River provides recharge to local groundwater, these changes in water quality characteristics in the river may subsequently affect groundwater characteristics. In addition, recharge to groundwater from the Thermalito Forebay and Afterbay may affect groundwater quality as well as levels. Ponds in the Oroville

Wildlife Area are likely hydraulically connected to the Feather River, and thus may also be affected by the water quality characteristics of the Feather River.

Though the project may potentially affect biological characteristics of groundwater, aquatic macro invertebrates as a component of the biological characteristics of groundwater are not included for study since sufficient information about these organisms is being obtained from riffle areas of the Feather River in Study Plan SP-W1. However, if information from this study suggests that there may be adverse effects to the biological hyporheic element, then studies will be developed in collaboration with the Environmental Workgroup and Task Force to examine those effects.

Prior to issuance of a new license for the project, the Federal Energy Regulatory Commission (FERC) will require a water quality certification by the State Water Resources Control Board (SWRCB). The certification requires a determination by the SWRCB that the project complies with appropriate requirements of the Central Valley Regional Water Quality Control Board (CVRWQCB) Basin Plan, which includes water quality objectives for protection of designated beneficial uses. The CVRWQCB has established groundwater quality objectives for bacteria, chemical constituents, radioactivity, tastes and odors, and toxicity.

Information obtained from the study will be used to determine project effects to the physical, chemical, and biological components of groundwater, demonstrate compliance with water quality standards and other appropriate requirements in the application for water quality certification, and identify the need for project modification or mitigation for impacts to groundwater quality or levels from project operations. Water quality analysis is required for determination of conditions in the water quality certification by the SWRCB.

4.0 Study Area

The study will include areas where groundwater is anticipated to be affected by project features and one or more reference sites up gradient from potential project effects. These include areas adjacent to the west and south of the Thermalito Forebay, areas adjacent to the west, south and east of the Thermalito Afterbay, and areas along the Feather River, from the Fish Barrier Dam to the southern boundary of the Oroville Wildlife Area.

Study plans approved by the Environmental Work Group define the limits of the study area. If initial study results indicate that the study area should be expanded or contracted, the Environmental Work Group will discuss the basis for change and revise the study area as appropriate.

5.0 General Approach

Detailed Methodology and Analysis Procedures This study will evaluate effects from project features to groundwater and hyporheic zones along the Feather River. Effects to groundwater levels and quality will be conducted in phases. The first phase will review current groundwater monitoring data to determine whether sufficient data are available to evaluate project effects to groundwater. If sufficient data are not available, a subsequent phase will obtain the necessary information. If initial study results indicate that the methods and

tasks should be modified, the Environmental Work Group will discuss the basis for change and revise the study plan as appropriate.

Task 1, Phase 1—Inventory Existing Wells and Assessment of Existing Groundwater Data and Current Groundwater Monitoring Activities

An inventory of wells located in the specified field areas will be made utilizing records maintained at the California Department of Water Resources (DWR). Shallow wells (100 feet deep or less) will be identified for use in this study because potential impacts to groundwater from the Thermalito project features would likely occur in a shallow, unconfined setting. Available logs for these wells will be reviewed to ensure a general consistency of subsurface materials was encountered during drilling. Logs of deeper wells and logs of wells that indicate substantially different and varying earth materials that were encountered during drilling will be set aside for possible more intensive lithologic and hydrogeologic interpretation, if needed. Wells will be categorized according to location, surface elevation, depth, design, and use; this data will then be entered into a GIS database. This will allow the data to be presented graphically in a variety of ways, and will allow the inclusion of additional data collected subsequently.

Monitoring of groundwater levels and groundwater quality in some wells within the field areas is being conducted by DWR as part of its ongoing groundwater monitoring program for the DWR Northern District. In addition, a number of monitoring wells were constructed shortly after completion of the project to evaluate the effects on groundwater levels of seepage from the Afterbay and pumps installed to collect the seepage. These data and other available groundwater level and groundwater quality data from the selected wells will be collected from DWR and CVRWQCB records and other sources, such as cooperative well owners. The compiled data will be reviewed and compared as appropriate to surface water level and surface water quality data collected from the Thermalito Forebay and Afterbay as part of the Oroville Facilities FERC Study Plan SP-W-1 (Project Effects on Water Quality Designated Beneficial Uses for Surface Waters). Other available and appropriate data collected from these surface water features will also be compared to the available well data.

The groundwater level data from the wells will be scrutinized to determine if there appear to be localized effects on the water table from the Thermalito Forebay and Afterbay. It is anticipated that a mounding of the water table will be evident from the groundwater level data. The Ground Water Model of Butte County will be reviewed and may be used to help identify project effects to water levels. Similarly, groundwater quality data will be compared to the water quality of the Thermalito project features to determine if the surface water features are affecting groundwater quality.

Task 1, Phase 2—Groundwater Monitoring

Some of the existing wells within the identified field areas for this study are currently monitored by the DWR as part of its groundwater level and groundwater quality monitoring program for the DWR Northern District. Wells monitored in this program are measured during the spring, summer (July and August), and fall for water levels, and biennially during the summer for water quality. If available data, including data from this existing monitoring program, are not sufficient to determine effects from the Thermalito project features to groundwater, then additional monitoring may be necessary. Additional monitoring may necessitate the construction of additional wells and/or piezometers. Frequency of additional groundwater level monitoring and degree of the groundwater quality analysis will depend on findings in Phase 1.

Should additional monitoring be necessary, groundwater levels will be measured in monitoring wells and piezometers, and in pumping wells that have been inactive for one week or more. Active pumping wells will not be measured or sampled. In general, groundwater level and groundwater quality sampling will be conducted in the spring, summer, and fall. Should groundwater samples be collected for additional monitoring, they will be analyzed for general mineral composition and physical parameters such as pH, conductivity, and temperature at the time of sampling. The general mineral analysis will enable the ionic composition of the groundwater to be compared with the ionic signature of water collected from the Thermalito features in Study Plan SP-W1. Similarly, the physical parameters of the groundwater samples can be compared to surface water samples from the Thermalito features.

Depending on comparison results, the groundwater samples may also be analyzed for a suite of parameters similar to those for which surface water samples will be analyzed as part of Study Plan SP-W1, including methyl tert-butyl ether (MTBE), total and fecal coliform bacteria, metals, and select pesticides. Table SP-W5-1 is a list of these potential analytes and corresponding EPA-approved analytical methodology. Chemical analyses for minerals, nutrients, metals, pesticides, and total dissolved solids would be performed at the DWR Bryte Chemical Laboratory in West Sacramento, California. Analyses for total and fecal coliform bacteria would be conducted by the DWR laboratory in Red Bluff, California.

Table SP-W5-1. Analytical methods and detection levels

Method	Analysis	Units	Reporting Limit
Minerals			
EPA 200 7 (D)	Dissolved Calcium	mg/L	1
EPA 200.7 (D)	Dissolved Sodium	mg/L	1
EPA 200.7 (D)	Dissolved Potassium	mg/L	0.5
EPA200.7 (D)	Dissolved Magnesium	mg/L	1
EPA 300.0 (28d hold)	Dissolved Sulfate	mg/L	1
EPA 300.0 28d Hold	Dissolved Chloride	mg/L	1
EPA 200.7 (D)	Dissolved Boron	mg/L	0.1
Std Method 2320 B	Alkalinity	mg CaCO3/L	0.1
Nutrients			
Std Method 4500-NO3-F Modified	Dissolved Nitrite + Nitrate	mg/L as N	0.05
EPA 350.1	Dissolved Ammonia	mg/L as N	0.02
Std Method 4500-NH3	Total Ammonia	mg/L as N	0.02
EPA 365.1	Dissolved Ortho-phosphate	mg/L as P	0.01
EPA 365.4	Total Phosphorus	mg/L	0.01
Metals			

EPA 1631	Total Mercury	ug/L	0.0002
EPA 1631	Total Methyl Mercury	ug/L	0.005
EPA 1632	Total and Dissolved Arsenic	ug/L	0.004
Std Method 3500-Fe D	Total and Dissolved Iron	ug/L	2.2
EPA 1638	Total and Dissolved Aluminum	ug/L	0.4
EPA 1638	Total and Dissolved Cadmium	ug/L	0.003
EPA 1638	Total and Dissolved Chromium	ug/L	0.03
EPA 1638	Total and Dissolved Copper	ug/L	0.01
EPA 1638	Total and Dissolved Lead	ug/L	0.005
EPA 1638	Total and Dissolved Manganese	ug/L	0.02
EPA 1638	Total and Dissolved Nickel	ug/L	0.01
EPA 1638	Total Selenium	ug/L	0.1
EPA 1638	Total and Dissolved Zinc	ug/L	0.03
Miscellaneous			
Std Method 2540 C	Total Dissolved Solids	mg/L	1
Std Method 2340 B	Hardness	mg/L as CaCO3	1
Std Method 2550 B 1	Temperature	degree Celsius	0.1
Std Method 4500-O C	Dissolved oxygen	mg/L	0.1
Std Methods 4500-H+ B	pH	pH units	0.1
Std Method 2510 B	Conductivity	umhos/cm	0.1
Pathogens			
Std Method 9222 B	Total Coliform bacteria	colonies/100 mL	0
Std Method 9222 D	Fecal Coliform bacteria	colonies/100 mL	0
Pesticides			
Chlorinated Organic Pesticides			
EPA 508	Alachlor	µg/L	0.05
EPA 508	Aldrin	µg/L	0.01
EPA 508	Atrazine	µg/L	0.02
EPA 508	BHC-alpha	µg/L	0.01
EPA 508	BHC-beta	µg/L	0.01
EPA 508	BHC-delta	µg/L	0.01
EPA 508	BHC-gamma (Lindane)	µg/L	0.01
EPA 508	Captan	µg/L	0.02
EPA 508	Chlordane	µg/L	0.05
EPA 508	Chlorothalonil	µg/L	0.01
EPA 508	Chlorpropham	µg/L	0.02
EPA 508	Chlorpyrifos	µg/L	0.01

EPA 508	Cyanazine	µg/L	0.3
EPA 508	Dacthal (DCPA)	µg/L	0.01
EPA 508	Dichloran	µg/L	0.01
EPA 508	Dicofol	µg/L	0.05
EPA 508	Dieldrin	µg/L	0.01
EPA 508	Diuron	µg/L	0.25
EPA 508	Endosulfan sulfate	µg/L	0.02
EPA 508	Endosulfan-I	µg/L	0.01
EPA 508	Endosulfan-II	µg/L	0.01
EPA 508	Endrin	µg/L	0.01
EPA 508	Endrin aldehyde	µg/L	0.01
EPA 508	Heptachlor	µg/L	0.01
EPA 508	Heptachlor epoxide	µg/L	0.01
EPA 508	Methoxychlor	µg/L	0.05
EPA 508	Metolachlor	µg/L	0.2
EPA 508	Oxyfluorfen	µg/L	0.2
EPA 508	p,p'-DDD	µg/L	0.01
EPA 508	p,p'-DDE	µg/L	0.01
EPA 508	p,p'-DDT	µg/L	0.05
EPA 508	PCB-1016	µg/L	0.1
EPA 508	PCB-1221	µg/L	0.1
EPA 508	PCB-1232	µg/L	0.1
EPA 508	PCB-1242	µg/L	0.1
EPA 508	PCB-1248	µg/L	0.1
EPA 508	PCB-1254	µg/L	0.1
EPA 508	PCB-1260	µg/L	0.1
EPA 508	Pentachloronitrobenzene (PCNB)	µg/L	0.01
EPA 508	Ronnel	µg/L	0.3
EPA 508	Simazine	µg/L	0.02
EPA 508	Thiobencarb	µg/L	0.02
EPA 508	Toxaphene	µg/L	0.4
EPA 508	Trifluralin	µg/L	0.05
Organic Phosphorus Pesticides			
EPA 508	Azinphos methyl (Guthion)	µg/L	0.05
EPA 508	Benfluralin	µg/L	0.01
EPA 508	Bromacil	µg/L	1
EPA 508	Carbophenothion (Trithion)	µg/L	0.02
EPA 508	Chlorpyrifos	µg/L	0.01
EPA 508	Cyanazine	µg/L	0.3

EPA 508	Demeton (Demeton O + Demeton S)	µg/L	0.02
EPA 508	Diazinon	µg/L	0.01
EPA 508	Dimethoate	µg/L	0.01
EPA 508	Disulfoton	µg/L	0.01
EPA 508	Ethion	µg/L	0.01
EPA 508	Malathion	µg/L	0.01
EPA 508	Methidathion	µg/L	0.02
EPA 508	Mevinphos	µg/L	0.01
EPA 508	Naled	µg/L	0.02
EPA 508	Napropamide	µg/L	5
EPA 508	Norflurazon	µg/L	5
EPA 508	Parathion (Ethyl)	µg/L	0.01
EPA 508	Parathion, Methyl	µg/L	0.01
EPA 508	Pendimethalin	µg/L	5
EPA 508	Phorate	µg/L	0.01
EPA 508	Phosalone	µg/L	0.02
EPA 508	Phosmet	µg/L	0.02
EPA 508	Profenofos	µg/L	0.01
EPA 508	Prometryn	µg/L	0.05
EPA 508	Propetamphos	µg/L	0.1
EPA 508	Ronnel	µg/L	0.01
EPA 508	s,s,s-Tributyl Phosphorotrithioate (DEF)	µg/L	0.01
EPA 508	Trifluralin	µg/L	0.01
Volatile Organics (Purgeable)			
EPA 502.2	1,1,1,2-Tetrachloroethane	µg/L	0.5
EPA 502.2	1,1,1-Trichloroethane	µg/L	0.5
EPA 502.2	1,1,2,2-Tetrachloroethane	µg/L	0.5
EPA 502.2	1,1,2-Trichloroethane	µg/L	0.5
EPA 502.2	1,1-Dichloroethane	µg/L	0.5
EPA 502.2	1,1-Dichloroethene	µg/L	0.5
EPA 502.2	1,1-Dichloropropene	µg/L	0.5
EPA 502.2	1,2,3-Trichlorobenzene	µg/L	0.5
EPA 502.2	1,2,3-Trichloropropane	µg/L	0.5
EPA 502.2	1,2,4-Trichlorobenzene	µg/L	0.5
EPA 502.2	1,2,4-Trimethylbenzene	µg/L	0.5
EPA 502.2	1,2-Dibromo-3-chloropropane (DBCP)	µg/L	0.5
EPA 502.2	1,2-Dibromoethane	µg/L	0.5

EPA 502.2	1,2-Dichlorobenzene	µg/L	0.5
EPA 502.2	1,2-Dichloroethane	µg/L	0.5
Volatile Organics (Purgeable), continued			
EPA 502.2	1,2-Dichloropropane	µg/L	0.5
EPA 502.2	1,3,5-Trimethylbenzene	µg/L	0.5
EPA 502.2	1,3-Dichlorobenzene	µg/L	0.5
EPA 502.2	1,3-Dichloropropane	µg/L	0.5
EPA 502.2	1,4-Dichlorobenzene	µg/L	0.5
EPA 502.2	2,2-Dichloropropane	µg/L	0.5
EPA 502.2	2-Chlorotoluene	µg/L	0.5
EPA 502.2	4-Chlorotoluene	µg/L	0.5
EPA 502.2	4-Isopropyltoluene	µg/L	0.5
EPA 502.2	Benzene	µg/L	0.5
EPA 502.2	Bromobenzene	µg/L	0.5
EPA 502.2	Bromochloromethane	µg/L	0.5
EPA 502.2	Bromodichloromethane	µg/L	0.5
EPA 502.2	Bromoform	µg/L	0.5
EPA 502.2	Bromomethane	µg/L	0.5
EPA 502.2	Carbon tetrachloride	µg/L	0.5
EPA 502.2	Chlorobenzene	µg/L	0.5
EPA 502.2	Chloroethane	µg/L	0.5
EPA 502.2	Chloroform	µg/L	0.5
EPA 502.2	Chloromethane	µg/L	0.5
EPA 502.2	cis-1,2-Dichloroethene	µg/L	0.5
EPA 502.2	cis-1,3-Dichloropropene	µg/L	0.5
EPA 502.2	Dibromochloromethane	µg/L	0.5
EPA 502.2	Dibromomethane	µg/L	0.5
EPA 502.2	Dichlorodifluoromethane	µg/L	0.5
EPA 502.2	Ethyl benzene	µg/L	0.5
EPA 502.2	Fluorobenzene	µg/L	0.5
EPA 502.2	Hexachlorobutadiene	µg/L	0.5
EPA 502.2	Isopropylbenzene	µg/L	0.5
EPA 502.2	m + p Xylene	µg/L	0.5
EPA 8260	Methyl tert-butyl ether (MTBE)	µg/L	0.5
EPA 502.2	Methylene chloride	µg/L	0.5
EPA 502.2	n-Butylbenzene	µg/L	0.5
EPA 502.2	n-Propylbenzene	µg/L	0.5
EPA 502.2	Naphthalene	µg/L	0.5
EPA 502.2	o-Xylene	µg/L	0.5

EPA 502.2	sec-Butylbenzene	µg/L	0.5
EPA 502.2	Styrene	µg/L	0.5
EPA 502.2	tert-Butylbenzene	µg/L	0.5
EPA 502.2	Tetrachloroethene	µg/L	0.5
EPA 502.2	Toluene	µg/L	0.5
EPA 502.2	trans-1,2-Dichloroethene	µg/L	0.5
EPA 502.2	trans-1,3-Dichloropropene	µg/L	0.5
EPA 502.2	Trichloroethene	µg/L	0.5
EPA 502.2	Trichlorofluoromethane	µg/L	0.5
EPA 502.2	Vinyl chloride	µg/L	0.5
Chlorinated Phenoxy Acid Herbicides			
EPA 515.1	2,4,5-T	µg/L	0.1
EPA 515.1	2,4,5-TP (Silvex)	µg/L	0.1
EPA 515.1	2,4-D	µg/L	0.1
EPA 515.1	2,4-DB	µg/L	0.1
EPA 515.1	2,4-Dichlorophenylacetic acid (DCAA)	µg/L	0.1
EPA 515.1	Dacthal (DCPA)	µg/L	0.1
EPA 515.1	Dicamba	µg/L	0.1
EPA 515.1	Dichlorprop	µg/L	0.1
EPA 515.1	Dinoseb (DNPB)	µg/L	0.1
EPA 515.1	MCPA	µg/L	0.1
EPA 515.1	MCPP	µg/L	0.1
EPA 515.1	Pentachlorophenol (PCP)	µg/L	0.1
EPA 515.1	Picloram	µg/L	0.1
EPA 515.1	Triclopyr	µg/L	0.1
Glyphosate			
EPA 547	Aminomethylphosphonic Acid (AMPA)	µg/L	100
EPA 547	Glyphosate	µg/L	100
Carbamate Pesticides			
EPA 531.1	3-Hydroxycarbofuran	µg/L	2
EPA 531.1	Aldicarb	µg/L	2
EPA 531.1	Aldicarb sulfone	µg/L	2
EPA 531.1	Aldicarb sulfoxide	µg/L	2
EPA 531.1	Carbaryl	µg/L	2
EPA 531.1	Carbofuran	µg/L	2

EPA 531.1	Formetanate hydrochloride	µg/L	100
EPA 531.1	Methiocarb	µg/L	4
EPA 531.1	Methomyl	µg/L	2
EPA 531.1	Oxamyl	µg/L	2
Pyrethrins	will be analyzed if suitable methods are identified through discussions with the Department of Pesticide Regulation		

Task 2—Hyporheic Monitoring

Hyporheic zones along the Feather River will be monitored by collecting water level and monthly water quality data from ponds in the Oroville Wildlife Area. These data will be compared to river stage level and water quality data collected from the Feather River downstream from the Fish Barrier Dam as part of Study Plan SP-W1. Stage recorders will be used to measure and record water level changes at 15-minute intervals in ponds and the river. Existing wells and piezometers, which may lie between the ponds and river, may also be used for data collection. Parameters analyzed from the ponds would include those found to be present in the Feather River in Study Plan SP-W1. Pond locations and dimensions, stage recorder locations, well and/or piezometer locations, and water level data will be entered into a GIS database.

Both the water level and water quality data sets will indicate the degree of hydraulic connectivity between the river and the ponds. Fluctuations in pond water levels will be compared to different stages of the Feather River to determine if pond water level and river stage levels are temporally related. Pond water quality will be compared to river water quality to determine if constituents found in the river water are also in the pond water.

Additional shallow monitoring wells or piezometers may be constructed between the river and ponds to aid in river stage-pond level and source water determinations. If physical and chemical data indicate concern for groundwater contamination, then effects on benthic macroinvertebrates in the hyporheic zone may need to be analyzed in a subsequent phase of the study. The need for subsequent phases will be discussed with the Environmental Work Group after analyses and presentation of data from this study.

Task 3—Progress Report

Progress reports will be prepared at the conclusion of the first and subsequent phases of the study. Interim output products will be identified through coordination with other work groups to meet their data needs.

Task 4—Final Report

A final report will be prepared following completion of the study.

6.0 Results and Products/Deliverables

Results

Groundwater level data compiled as part of Task 1, Phase 1, as well as Thermalito Forebay and Afterbay water level data compiled for Study Plan SP-W-1, will be used to generate potentiometric maps to illustrate the physical influence or lack of influence that the Thermalito project features have on groundwater. Groundwater analytical data compiled under Phase 1 and, if needed, under Task 1, Phase 2 will be compared with surface water quality data collected from the Thermalito project features under Study Plan SP-W1. Specifically, the ionic composition and physical characteristics of the groundwater will be compared to that of the surface waters of the Thermalito Forebay and Afterbay. This data will be displayed using Stiff diagrams or similar graphics. Waters showing similar or identical ionic compositions and similar or identical physical traits indicate the waters may be of the same origin. Water quality data from the Thermalito Forebay and Afterbay will be reviewed to determine if there are any deleterious substances in the water. Groundwater quality data compiled under Task 1 and, if needed, Task 2, will be reviewed to determine if the same substances were detected.

A brief report will be prepared after Task 1, Phase 1 is complete. The report will present an appendix of all wells used to assess the potential affects of the Thermalito Forebay and Afterbay on groundwater levels and groundwater quality. The appendix will be generated from the compiled GIS database; it will have the well name, location, elevation, depth, use, and other pertinent data. Non-confidential information from well logs and well constructions, if available, will be presented in a second appendix. A third appendix will present the groundwater level and groundwater quality data for those wells used to assess potential impacts from the Thermalito Forebay and Afterbay. A fourth appendix will present pertinent data obtained from Study Plan SP-W1 and used for this study. The report will present potentiometric maps generated from the GIS database, which will illustrate groundwater levels in the vicinity of the Thermalito Forebay and Afterbay. It will also present tables, graphs and figures which detail and compare the general mineral chemistry and quality of the groundwater to the general mineral chemistry and quality of the Thermalito surface waters obtained from Study Plan SP-W1. The report will include an interpretation of potential groundwater influences of the Thermalito project features based on the presented data. The report will assess the need to construct additional wells or piezometers and conduct additional groundwater sampling and analyses, as detailed in Task 1, Phase 2.

If Phase 2 is conducted, a second report will be prepared following the conclusion of that phase in which all data are presented in appendices, and the potential affects of the Thermalito Forebay and Afterbay on groundwater levels and quality are assessed. The report will contain similar tables, graphs, figures, and maps as the report prepared for Phase 1, and will include evaluation of the groundwater influences of Thermalito project waters on groundwater levels and quality.

A third report will be prepared to present and discuss hyporheic data obtained under Task 2. The report will have maps generated from the GIS database which illustrate the locations of select ponds in the Oroville Wildlife Area relative to the Feather River. Cross sections will also be generated to illustrate recorded temporal changes in pond water levels and river stage levels. These illustrations will demonstrate the physical existence, or lack of existence, of hyporheic connections between the ponds and the Feather River. Pond water quality collected as part of Task 2, in conjunction with Feather River water quality data collected as part of

Study Plan SP-W1, will be used to determine if the pond water quality and river water quality have similar chemical signatures, possibly indicating more subtle hyporheic connections. The report will present tables, graphs, and figures which detail and compare pond water general mineral chemistry and quality to the river water general mineral chemistry and quality. Other water quality analytical data will be reviewed to determine if there are any deleterious substances in the pond water that are also present in the river water. The report will interpret the presented data, providing a qualitative estimated extent to which the Feather River is hydraulically connected to ponds in the Oroville Wildlife Area, and it will assess the need to construct additional wells or piezometers. The report will include an appendix of all water level and analytical data used for this task.

Compliance with groundwater quality objectives will be used to evaluate project effects on designated beneficial uses for groundwater in the project area as defined in the Basin Plan. Information developed from this study will be presented to the SWRCB for review and determination of conditions to be included in the water quality certification to comply with Section 401 of the Federal Clean Water Act. The certification requires a determination by the SWRCB that the project complies with appropriate requirements of the CVRWQCB Basin Plan. The water quality certification is needed for license renewal by FERC.

7.0 Coordination and Implementation Strategy

Coordination with Other Resource Areas/Studies

This study will provide information for determination of project compliance with water quality standards and other appropriate requirements in the application for water quality certification.

This study will be coordinated with Study Plan SP-W1(Project Effects on Water Quality Designated Beneficial Uses for Surface Waters), and use water quality data for the Feather River from that study for comparison with groundwater quality data. The study will also be coordinated with Study Plan SP-W2 (Contaminant Accumulation in Fish, Sediments, and the Aquatic Food Chain) for determination of hyporheic effects on contaminant accumulation in aquatic organisms in the Oroville Wildlife Area ponds. Water quality information from the ponds developed by this study will be used in the terrestrial and fisheries studies to evaluate any effects to terrestrial and fish species.

Issues

This study plan provides information for evaluation of Issue Statement W17 (Effects of reservoirs and Feather River downstream of Oroville Dam on groundwater quality and quantity (e.g. hyporheic zone interaction). This study fully or partially addresses the following Stakeholder issues:

Stakeholder issues fully addressed by SP-W5 Project Effects on Groundwater

- WE 55. Effects of reservoirs and Feather River downstream of Oroville Dam on groundwater quality and quantity (e.g. hyporheic zone interaction).

Stakeholder issues partially addressed by SP-W5 Project Effects on Groundwater

8.0 Study Schedule

Task 1 of the study will begin in the spring of 2002. The initial phase of this task will consist of compiling a catalogue of wells in the field areas around the Thermalito Forebay and Afterbay and determining which wells will be useful for determining potential impacts to groundwater from the Thermalito project features. The groundwater model will also be reviewed for relevant information. A review of existing groundwater quality data for these wells will be performed, including a review of data currently being collected from select wells which are part of the DWR Northern District groundwater level and groundwater quality monitoring program. Data from Study Plan SP-W1 will also need to be acquired at this stage. A brief report as summarized in Section 6.0 of this study plan will be prepared based on the compiled data and is anticipated to be completed by late 2002.

Task 1, Phase 2 of the study will be conducted depending on the findings of the Task 1, Phase 1 summary report. If Phase 2 is needed, groundwater level measurement and water quality data collection would begin in the spring of 2003, and may continue through the fall of 2004. A report would be completed in 2004 following data collection activities.

Data collection for Task 2 will begin in the spring of 2002 and conclude at the end of spring in 2004. Pond water level measurements and collection of pond water samples for water quality analysis will be coordinated with river water data collection conducted as part of Study Plan SP-W1. A brief report as summarize in Section 6.0 of this study plan will be prepared based on the collected data. This report is anticipated to be completed by mid 2004.

Information developed in this study will be presented quarterly to the Environmental Work Group and Task Force for review to evaluate the adequacy and progress of the study, and to provide information needed by the other environmental work groups.

9.0 References

CVRWQCB 1998. The Water Quality Control Plan (Basin Plan) for the California Regional Water Quality Control Board, Central Valley Region, Fourth edition. The Sacramento River Basin and the San Joaquin River Basin. CVRWQCB, Sacramento http://www.swrcb.ca.gov/rwqcb5/available_documents/index.html